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Economic evaluation of management strategies for a model Waikato farm to achieve a herd average body condition score of 5.0 at calving

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ABSTRACT

Industry advisers advocate a herd average body condition score (BCS) of 5 at calving to optimise profitability and system sustainability. However, the full value and cost of achieving the industry target has not been evaluated. Using the Farmax Dairy Pro model, the value of increasing the herd average BCS at calving from 4.0 to 5.0 was evaluated. A representative Waikato farm with a single dry off date in mid-May, with a herd average BCS of 4.0 at calving was modelled as the Base scenario. The profitability of seven alternative scenarios that achieved average herd BCS of 5.0 at calving were examined. Strategies that traded off autumn production to attain target BCS maintained a similar operating profit (OP) of -\$46/ha to \$3/ha, relative to the Base scenario. Partial season once-a-day milking increased OP by \$220/ha to \$269/ha, as long lactations and BCS targets were able to be achieved while reducing operating expenses. Additional supplements fed to dry cows to achieve target BCS increased OP by \$43/ha. Additional mid-late lactation feeding increased OP by \$139/ha to \$269/ha, but only effected BCS by 0.15 units during lactation. These simulations indicate there is value in achieving recommended BCS targets, with multiple profitable strategies to do so.

Keywords: dairying; economic evaluation; management strategy; body condition score; calving.

INTRODUCTION

Industry experts recommend a calving body condition score (BCS) of 5.0 for mixed age cows and 5.5 for first and second calvers (Macdonald & Roche; 2004). These targets are a compromise between maximising a cow's milk production and reproduction potential, while not compromising health at calving due to excessive fatness (Roche *et al.*, 2009). Although a BCS of 5.0 is accepted by most as the appropriate target, calving BCS on many well managed farms has tended to decline, with cows calving at between 4.0 and 4.5 in recent years (Roche, Unpublished data).

Cows calving at less than BCS 5.0 will produce less milksolids, take longer to cycle, and have lower conception rates early in the breeding period (Roche *et al.*, 2009). This reduces farm revenue and has the potential to reduce profit. However, historical financial analyses have not accounted for all benefits and costs associated with changing calving BCS, making the value proposition of achieving the targets difficult to ascertain. Advances in farm simulation modelling enable all factors to be accounted for, allowing the true value of calving BCS targets to be determined.

A number of options exist to ensure calving BCS targets are attained. "Early dry off decision rules" were developed when the price of supplements relative to the price of milk made supplementation uneconomic. These decision rules involve assessing BCS during February, March, and April, with cows under certain thresholds each

month dried off (Macdonald & Penno, 1998). These thresholds enable cows to achieve the desired calving BCS if offered sufficient pasture of approximately 10 kg DM/cow/day (Macdonald & Roche, 2004). However, use of maize silage and palm kernel extract (PKE), the development of brassica-based wintering systems in the South Island and higher milk prices have led to longer lactations and the use of these feeds to gain BCS either during late lactation or during the dry period. In addition, once-a-day milking (OAD) after Christmas has been used successfully on many farms to improve lifestyle and allow cows to recover BCS during lactation.

The objective of this study was to investigate the relative profitability of a number of management options to achieve the industry target BCS of 5.0 at calving compared with cows calving at BCS 4.0.

MATERIALS AND METHODS

Different management strategies to achieve a BCS 5.0 at calving were evaluated using Farmax Dairy Pro (Bryant *et al.*, 2010a). A typical low input Waikato farm, where cows are dried off in mid-May and calve at an average BCS of 4.0 for multiparous cows (Base) was compared with farms that achieve a BCS of 5.0 in multiparous cows at calving using different management strategies. All of the scenarios represent a similar level of management skill and feasibility. There was no treatment applied to primiparous cows.

Base Farm

In the present study, a representative Waikato farm was simulated in consultation with industry experts (Bryant *et al.*, 2010b). The farm was 119 effective hectares which were predominately flat, with 358 average genetic merit crossbred cows at peak lactation that were stocked at 3.0/ha, with calving commencing on the 20th of July. The herd achieved a milksolids production (MS) of 938 kg/ha and 312 kg/cow. Home grown pasture and crop eaten was 12.2 t DM/ha plus 0.9 t DM/ha of imported supplementary feed. All cows were wintered on the farm. There was a single dry off date of 18 May, with dry cows split on the basis of BCS during winter and differentially fed to reduce the range of BCS. Multiparous cows achieved a calving BCS of 4.0. There was an average pasture cover (APC) of 2,150 kg DM/ha at calving.

Alternative management scenarios modelled

In all of the alternative management scenarios, cows were either dried off, milked OAD or fed extra supplement so that all scenarios resulted in cows calving at BCS 5.0 and an APC of 2,150 kg DM/ha at calving.

Seven alternative scenarios were modelled:

Treatment 1: Dry off rules

This scenario, applied the DairyNZ “dry off decision rules” (Macdonald & Penno, 1998). Dry cows were fed approximately 4 kg DM/day of supplement March to May with a total feed allowance of 10 kg DM/cow/day. Cows were dried off under the following conditions:

- Cows <3.25 BCS dried off at the start of March.
- Cows <3.75 BCS dried off at the start of April.
- Cows <4.25 BCS dried off at the start of May.
- Final dry off 18 May.

Treatment 2: Dry off one month earlier plus supplement with no feed pad

In this scenario, the whole herd was dried off a month earlier than the Base on 15 April then feeding the dry cows to get the herd to target BCS before winter.

Treatment 3: Dry off two weeks earlier plus supplement with no feed pad

In this scenario, the whole herd was dried off two weeks earlier on 1 May with dry cows fed 4 kg DM/cow/day of supplement through May to gain condition before winter.

Treatment 4: Intensify with feed pad

In this scenario, the milking herd was fed an additional 2 kg DM/cow/day of supplement from February to April and an additional 4 kg DM/cow/day of supplement in May. Dry off was the 28 May. An additional 2 kg DM/cow/day of supplement was fed to dry cows during winter for BCS gain.

Treatment 5: Supplement dry cows with feed pad

This scenario was identical to the base model until dry off on 18 May after which additional supplement was fed to dry cows on a feed pad. An additional 2, 3 and 2 kg DM/cow/day supplement was fed in May, June and July, respectively.

Treatment 6: OAD with dry off rules

In this scenario, whole herd OAD milking was applied from 1 January, with cows dried off as per the decision rules described for Treatment 1.

Treatment 7: OAD plus supplement with no feed pad

Whole herd OAD milking from 1 January. Lactation extended by feeding an additional 200 kg DM/cow of supplement to the milking cows from January to May and milking until the 28 May.

The key features of the different systems are presented in Table 1.

The model

Different management strategies to achieve BCS 5.0 at calving were evaluated using Farmax Dairy Pro (Bryant *et al.*, 2010a). Farmax Dairy Pro is a whole-farm decision support model that uses monthly estimates of pasture growth, and farm and herd information to determine production and economic outcomes of managerial decisions. Relevant to this study, the model predicts a distribution of condition score based on herd average condition score. This enables the user to dry off all or part of the herd based on condition score thresholds. The poor condition score cows can then be fed preferentially.

Simulations

Farmax Dairy Pro was used in short term mode with a 24 month model representing two full dairy seasons. The alternative management scenarios were all undertaken in the second half of the first season and the start of the following season (January – July), with no management differences in the first seven, or last ten months of the model. The results presented are for the 12 months from 1 January to 31 December inclusive, in the middle of the 24-month model period. They represent the annual effect of the management changes made from January to July. All scenarios had the same APC of 2,300 kg DM/ha and the same BCS of 3.9 at the start of the reported period. They were each managed to achieve the same APC at calving of 2,150 kg DM/ha. With no management differences from August to December, the scenarios were within 0.13 units of BCS and 10 kg DM/ha APC of each other by 31 December. Therefore, this study approximates the long term cost/benefit of attaining target BCS rather than a change-over year and investment in increasing BCS at calving with only a small capital investment component.

TABLE 1: Key physical features of systems designed to achieve a calving BCS of 5.0 for multiparous cows, compared with the Base farm where multiparous cows calved at BCS 4.0. Treatment 1 = Dry off rules; Treatment 2 = Dry off one month earlier plus supplement with no feed pad; Treatment 3 = Dry off two weeks earlier plus supplement with no feed pad; Treatment 4 = Intensify with feed pad; Treatment 5 = Supplement dry cows with feed pad rules; Treatment 6 = Once-a-day with dry off rules; Treatment 7 = Once-a-day plus supplement with no feed pad.

Physical feature	Base	Treatment						
		1	2	3	4	5	6	7
MS/ha supplied to factory (kg)	939	949	934	952	1,050	977	950	990
MS/ha produced June to Dec (kg)	669	694	692	691	696	694	698	699
MS/ha produced Jan to May (kg)	285	268	255	273	366	295	264	305
Lactation length (days)	275	246	243	258	285	275	269	285
Average pasture cover at calving (kgDM/ha)	2,150	2,150	2,150	2,150	2,150	2,150	2,150	2,150
Body condition score at calving	4.3	5.0	5.0	5.0	5.0	5.0	5.0	5.0

Other assumptions

DairyNZ forecasts of average operating expenses for Waikato/Bay of Plenty owner operators in the 2010/2011 season were used along with a milk price of \$6.00/kg MS. Supplement prices were: Maize silage \$320/t DM; PKE at \$311/t DM (\$280/t wet) plus an additional \$50/t DM for maize silage and \$22/t DM for PKE as the cost to feed out.

The addition of a feed pad into the system was assumed to improve feed utilisation from 70 to 85% for maize silage and 85 to 90% for PKE compared with the base scenario. The capital cost of installing the feed pad was assumed to be \$377/cow wintered (R.D. Longhurst, Personal communication). Linear depreciation of 5% per year, an opportunity cost of capital of 8% as well as an annual maintenance cost of \$10/cow was assumed. The total annualised cost of the feed pad was \$59/cow or \$179/ha.

Options that undertook whole herd OAD milking from 1 January were assumed to lower employed labour costs by 10%, farm dairy expenses by 20%, electricity by 10% and repairs and maintenance by 10% over the whole season. This resulted in an annual reduction in operating expenses of \$33/cow or \$100/ha.

The reproductive benefits of BCS at calving of 5.0 vs. 4.0 (Roche *et al.*, 2009) were not represented physically in the Farmax Dairy Pro model and were adjusted economically post-simulation. The reproductive benefits were assumed to be \$40/multiparous cow. This figure represents the economic benefit of a 3% increase in the six-week in-calf rate, final empty rates reduced by 1.5%, reduced CIDR usage of 7% of the herd the following season and the carryover effect of this for another season (Burke *et al.*, 2008).

RESULTS AND DISCUSSION

Autumn production versus lactation length

Several management strategies (Treatments 1, 2, 3 and 6) traded off autumn milk production for spring milk production, when compared with the base scenario. Average lactation length was reduced by between 4 and 32 days and autumn production was reduced by between 12 and 30 kg MS/ha (Table 1). Annual production, however, was largely maintained through increased production in the first half of the following season, which resulted from the increased calving BCS. Despite this, all of these management scenarios required additional supplementation ranging from 14 to 129 kg DM/ha to achieve the target BCS. Excluding the OAD option, which had another influence, the options that reduced autumn production resulted in similar levels of profitability to the Base scenario. The additional supplement required added costs that were similar to the economic benefit of the increased reproductive performance. The scenario that followed the dry off rules had a herd average BCS trajectory similar to options that maintained a single dry off event (Figure 1 (c) and (d)), but had a smaller range in BCS at calving, which is more desirable.

Autumn supplements to lactating cows

Treatments 4 and 7 included additional supplementary feed offered to lactating cows in the autumn. These scenarios contrasted in the timing of the milksolids response to the additional supplement, Treatment 7 gained BCS during lactation, which was then mobilised the following season. Treatment 4 put on little additional condition during lactation with the majority of the additional feed turning into autumn milksolids production. The BCS was 0.15 BCS units above the Base by 1 May. Supplement was then used during

the dry period to get to the target BCS (Figure 1 (a) and (b)).

Under Treatment 7, production was increased by 51 kg MS/ha compared with the Base. An additional 808 kg DM/ha of supplement was used. This equated to a system response to the supplement of 58 g MS/kg DM offered and is consistent with previous studies (Bargo *et al.*, 2003). This was achieved through an increase in lactation length of 10 days and daily production in the following season through increased BCS at calving. In Treatment 4, production was increased by 111 kg MS/ha, compared with the Base scenario. An additional 1,331 kg DM/ha of supplement was used. After removing the effect of the feed pad on increased autumn production, due to increased utilisation of supplement fed, the net production increase over the Base scenario was 101 kg MS/ha. There was a system response to the supplement in both the lactating cows and dry cows, of 76g MS/kg DM. Both of these scenarios increased operating profit compared with the Base scenario by \$139/ha and \$269/ha for Treatment 4 and 7 respectively (Table 2).

Supplements to dry cows for BCS gain

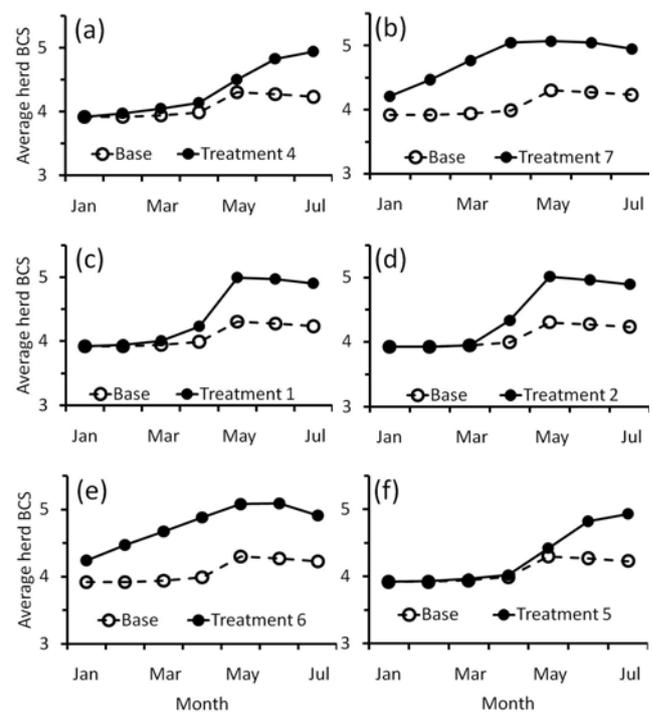
Treatment 5 required an additional 289 kg DM/cow of supplement fed on the feed pad to gain the additional 1.0 BCS in the multiparous cows. Overall an additional 656 kg DM/ha of supplement was used to increase milk production by 28 kg MS/ha, after removing the effect of the feed pad on increased autumn production through increased utilisation of supplement fed, or 43 g MS/kg DM without removal of the effect of the feed pad. This suggests a poor response to supplements (Bargo *et al.*, 2003).

Removing the annualised cost and effect of increased utilisation on autumn production due to the feed pad and feeding dry cows to reach the target BCS, increased operating profit by \$43/ha, including the reproductive benefits of increased BCS. This is only the case if supplements are able to be fed during the dry period, or the annualised costs associated with a feed pad would be incurred regardless of dry cow feeding management. As a system, installing a feed pad to feed dry cows for BCS gain reduced operating profit by \$76/ha compared with the Base scenario. However, such a scenario is unlikely.

Part season OAD milking

Treatments 6 and 7 used OAD milking for the whole herd from the 1 January onwards. Both of these scenarios ensured the cows gained sufficient BCS to reach calving target BCS during lactation (Figure 1). The Treatment 7 herd was able to gain condition faster with higher feed allowances. In both scenarios, milk production /cow was suppressed in

FIGURE 1: Body condition score profiles for the seven month period from Jan – July inclusive, in the Base farm where cows calved with a body condition score (BCS) of 4.0 and under different management strategies designed for multiparous cows to calve with a BCS of 5.0. Treatment 1 = Dry off rules; Treatment 2 = Dry off one month earlier plus supplement with no feed pad; Treatment 4 = Intensify with feed pad; Treatment 5 = Supplement dry cows with feed pad; Treatment 6 = Once-a-day with dry off rules; Treatment 7 = Once-a-day plus supplement with no feed pad.



mid/late lactation and the herd gained condition over this period. By late lactation, the herd was close to calving condition and could be milked for longer than other options tested. Total production was maintained or improved while also gaining the reproduction benefits of attaining target BCS. This was most evident when comparing the scenarios that applied the dry off decision rules. When comparing Treatment 6 to Treatment 1 with twice daily milking, average lactation length was increased by 23 days. This was because when OAD milking was applied, fewer cows were dried off at each BCS trigger point as they were in better condition. As a result, total production was maintained during the second half of the season with Treatment 6 than with Treatment 1, despite lower average daily per cow production.

The scenarios that adopted OAD had the highest operating profit of \$220/ha and \$269/ha above the Base scenario for Treatments 6 and 7, respectively. (Table 2).

TABLE 2: Economic results in the Base farm where cows calved with a body condition score (BCS) of 4.0 and under different management strategies designed for multiparous cows to calve with a BCS of 5.0. Treatment 1 = Dry off rules; Treatment 2 = Dry off one month earlier plus supplement with no feed pad; Treatment 3 = Dry off two weeks earlier plus supplement with no feed pad; Treatment 4 = Intensify with feed pad; Treatment 5 = Supplement dry cows with feed pad; Treatment 6 = Once-a-day with dry off rules; Treatment 7 = Once-a-day plus supplement with no feed pad.

Economic results	Base	Treatment						
		1	2	3	4	5	6	7
Feed costs per cow (\$/cow)	114	167	153	172	258	186	133	197
Operating expenses (\$/kg MS)	4.63	4.74	4.77	4.74	4.56	4.67	4.62	4.63
Stock sales (\$/kg MS)	0.35	0.35	0.36	0.34	0.31	0.34	0.36	0.34
Unadjusted operating profit/ha (\$/ha)	1,615	1,528	1,478	1,525	1,842	1,627	1,644	1,693
Adjustments								
Reproductive benefits (\$/ha)		91	91	91	91	91	91	91
Feed pad annualised cost (\$/ha)					-179	-179		
OAD reduced expenses (\$/ha)							100	100
Adjusted operating profit/ha (\$/ha)	1,615	1,619	1,569	1,616	1,754	1,539	1,835	1,884

TABLE 3: Effect of milk price and supplement price on the operating profit (\$/ha) of two potential management strategies that ensure a herd average BCS of 5.0 for multiparous cows at calving compared with the Base scenario. Figures in bold represent the assumed values used in this study. Treatment 4 = Intensify with feed pad; Treatment 6 = Once-a-day with dry off rules.

Strategy 1: Treatment 6 vs Base				Strategy 2: Treatment 4 vs Base			
Milk solids price (\$/kg MS)	Supplement price (c/kg/DM)			Milk solids price (\$/kg MS)	Supplement price (c/kg/DM)		
	40c	31c	22c		40c	31c	22c
\$5.00	+230	+209	+215	\$5.00	-82	+29	+141
\$6.00	+214	+220	+226	\$6.00	+28	+139	+250
\$7.00	+225	+231	+237	\$7.00	+138	+249	+360

Sensitivity to milk price and supplement cost

The sensitivity of two of the most profitable management scenarios (Treatments 4 and 6) to changes in milk price and supplement cost was analysed. The treatments represent contrasting approaches with Treatment 4 being more intensive and Treatment 6 a low input option. These were compared with the Base scenario (Table 3).

Treatment 6 was the most profitable low input option (Table 2). Total production and the amount of imported feed are similar to the Base scenario; therefore, the advantage is similar across a range of milk prices and feed costs. The increased profitability is the result of the economic benefit of improved reproductive performance along with reduced operating expenses associated with milking the herd OAD for part of the season.

Treatment 4, installing a feed pad and feeding 440 kg DM/cow of supplement compared with the Base scenario, was the most profitable twice a day milking option. Production increased 111 kg MS/ha, but with additional costs associated with feed, feeding out, and the annualised cost of the feed pad. Increased profit was highly dependent on the ratio

of feed to milk price. The option to intensify only becomes more profitable than the optimal low input scenario, when feed costs are low and milk price is high or if the costs associated with the feed pad investment would be incurred regardless (Table 3).

There are several factors that could alter the outcome of these management strategies on farm. All of the scenarios assume that management options are not limited by high somatic cell counts, cow suitability to OAD milking and that longer lactations were achieved under OAD if the cows do not need to be dried off for other reasons, such as high somatic cell counts. The results showing increased profitability with part season OAD milking are most applicable for low to medium input systems that achieve low to average production levels from January onwards as the trade-off of reduced daily milk production is small.

CONCLUSION

The simulated scenarios indicate that currently advocated BCS targets are still valid to maximise operating profit, with several profitable alternatives

to trading off autumn production on a low input Waikato farm. Management options to reach target BCS, such as part-season OAD, supplement feeding to dry cows, and late lactation supplements can be used to reach target BCS at calving and increase profit. The most profitable scenario involved partial season OAD, additional supplement to achieve BCS targets during lactation and maximising lactation length.

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